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(54) Hydraulic drilling machine of telescopic tower type with a rod stowing and handling system.

(57) A drilling machine of the type comprising a drilling tower (10) fixed in a reclinable manner on a transporting vehicle (11) and provided with motive power units (15) and a driving head (30) for driving the drill rods. The drilling tower is of telescopic type slidable along a fixed guide structure or lattice (24) by the action of a hydraulic piston (23), the telescopic tower (22) being provided at its ends with a series of pulleys (27, 35) to allow the movement of flexible transmission means (28, 34) having one end connected to said driving head (30) and the other end connected to a point on the fixed structure (24), so as to form a closed ring about the the tower (22).

The drilling machine is also provided with a system for stowing and handling the drilling rods.

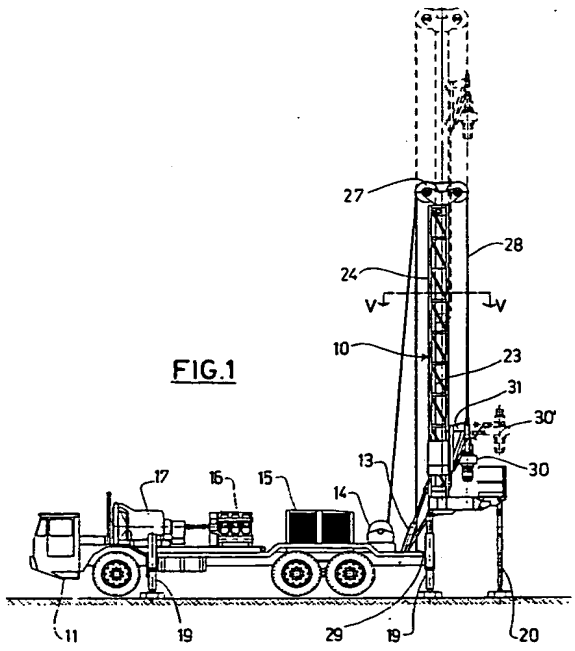

FIG.1

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This invention falls within the field of drilling rigs, and more particularly relates to a hydraulic drilling machine of telescopic tower type with a system for stowing and handling the drill rods.

In earth drilling, various types of drilling machines are known mounted for transportation on a truck or on a trailer or half trailer and provided with independent motive power units for rotating a cutting tool to form a hole, or enlarge a hole previously formed, in the ground.

A drilling machine of conventional type comprises a tower mounted on the transporting vehicle. During transportation the tower is laid horizontally on the transporting vehicle and is raised to a vertical position by hydraulic pistons or mechanical systems for normal operation.

Various auxiliary devices such as an air compressor, mud pump, handling and service winches etc. are also usually mounted on the transporting vehicle.

The driving head, to which the drill rods are fixed in a length determined by the tower height, is normally slidingly mounted on the tower.

To reduce the downtime required for joining the rods together during drilling, it is clearly advantageous to use a drilling rig which enables the longest possible rods to be utilized.

The main problem relating to such drilling machines regards their transport. In this respect, when a very tall tower is laid down on the transporting vehicle, serious size and manoeuvrability problems arise, with the possibility of it extending beyond the transport size limitations imposed by local laws.

An object of the invention is to provide a hydraulic drilling machine comprising a tower which enables long rods to be used while at the same time lying within the overall outline of the transporting vehicle.

During drilling and rod recovery, the rods are contained in a well immediately adjacent to the borehole, to be taken up (or deposited) one by one by the driving head.

Hence for each rod the driving head has to be moved from its position vertically above the borehole to a position above said well to enable it to take up or return a rod.

A further object of the invention is to provide a drilling machine comprising a simple and functional device for moving the driving head to enable it to tale up and/or deposit the individual drill rods when necessary.

A further object of the present invention is to provide a drilling machine in which the loads acting on the tower are arranged as symmetrically as possible about the tower axis in order to reduce bending stresses to a minimum.

A further object of the present invention is to provide the drilling machine with a system for handling the rod mounting and removal operations in an ordered and hence rapid manner during the respective drilling of the well and the rod extraction when the well is complete.

A further object of the invention is to provide a rod collection arrangement to enable the rods to be comfortably transported from one site to the next, in a manner already ordered and ready for use.

These and further objects and advantages, which will be more apparent hereinafter are attained according to the invention by a drilling machine of the type comprising a drilling tower fixed in a reclinable manner on a transporting vehicle and provided with motive power units and a driving head for driving the drill rods, characterised in that the drilling tower is of telescopic type slidable along a fixed guide structure or lattice by the action of a hydraulic piston, the telescopic tower being provided at its ends with a series of pulleys to allow the movement of flexible transmission means having one end connected to said driving head and the other end connected to a point on the fixed structure, so as to form a closed ring about the the tower.

A preferred but non-limiting embodiment of the drilling machine according to the invention is described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a side view of the drilling machine according to the invention in its operating position;

Figure 2 is a side view of the dilling machine in its transporting position;

Figure 3 is a schematic view of a detail of the drilling machine to an enlarged scale;

Figure 4 is a side view of a further detail of the machine according to the invention to an enlarged scale;

Figure 5 is a horizontal section on the line V-V of Figure 1 to an enlarged scale;

Figures 6 and 7 are respectively an elevation and plan view of a rod stowing and handling arrangement according to the invention; and

Figure 8 is a view of a detail of Figure 6 to an enlarged scale.

At various points in the following description, reference is made for simplicity to single elements which are in fact double, in that the accompanying drawings are mostly side views rather than perspective views, so that their depth is not shown.

On this basis, with reference to Figures 1 and 2 a drilling machine according to the invention comprises a drilling rig indicated overall by 10, securely hinged at 12 to the rear of a transporting vehicle 11 in which a diesel engine 17 and other auxiliary devices such as a mud pump or compressor 16, an independent motive power unit 15 and a handling winch 14 are mounted. The drilling rig 10

can be laid down nearly horizontally by rotating it in a vertical plane by means of hydraulic pistons 13. When in this transporting position, shown in Figure 2, the rig 10 rests at its front on a suitable frame 18 of the transporting vehicle 11 and completely lies within the overall outline of the vehicle.

With reference to Figure 1, the drilling machine comprises a series of hydraulic jacks 19 and mechanical screw jacks 20 to ensure that the drilling rig 10 is stable and vertical.

According to the invention, a telescopic tower 22 (Figures 3 and 5) of rectangular cross-section comprises in its interior a tubular hydraulic piston 23 of height virtually equal to that of the tower 22.

According to the invention, the tower 22 is able to slide within a support structure or lattice 24 when raised by the piston 23.

To facilitate sliding of the tower 22 within the lattice 24, a series of rollers 21 are provided interposed between mutually facing guides 25 and 26 rigid with the tower 22 and with the lattice 24 respectively (Figure 5). To achieve the same purpose other equivalent mechanical means can be used instead, such as guide systems with shoes.

A cable, chain or other flexible transmission means 28 passes about upper end pulleys 27 on the tower 22 and has one end fixed at 29 (Figures 1 and 3) to the truck 11 and its other end supporting a driving head of traditional type, indicated overall by 30, in which the drilling rods (not shown for simplicity) are clamped. As can be seen in Figures 1 and 2 and in the scheme of Figure 4, the driving head 30 is fixed to a frame 31 slidable vertically on the lattice 24 via rollers 32. To this frame there is fixed at 33 (Figure 3) one end of a secondary cable (or chain or other flexible means) 34, slidable about a pulley 35 pivoted in proximity to the lower end of the tower 22. The other end of the secondary cable 34 is fixed at 36 to a fixed point on the lattice 24 via a tensioning device 46.

As shown in Figure 4, the frame 31 supports the driving head 30 via an articulated quadrilateral linkage composed of a pair of rigid arms 40 and 41, both pivoted both to the frame 31 and to the head 30 and comprising a hydraulic piston 42 hinged at 43 to the frame 31 and at 44 to a lug 45 welded to the arm 41.

Again with reference to Figure 4 the articulated quadrilateral linkage is able to cause the driving head 30 to undergo a rotation-translation movement. In this respect, when the piston 42 extends, the arms 40 and 41 rotate anticlockwise to raise the head 30 and move it at the same time from the vertical line a, corresponding to the axis of the borehole, to the vertical line b (position shown dashed) coaxial with the service well for resting or taking up the drilling rods.

The operating cycle for the drilling rig 10 is as follows.

With reference to Figure 1, when a new drilling rod (not shown) is to be added to those already mounted, the telescopic tower 22 is initially at its lower end-of-travel position in the lattice 24.

When in this initial configuration the piston 23 is completely retracted and the tower 22 is contained within the lattice 24, from which the pulleys 27 project upperly.

By means of a hydraulic circuit (not shown for simplicity) the piston 42 of the articulated quadrilateral linkage is made to expand, to move the driving head 30 into the dashed configuration 30' to enable a new drilling rod taken from the service well to be fitted. By means of a main hydraulic circuit (not shown for simplicity) the piston 23 is made to expand, with consequent raising of the tower 22 within the lattice 24. During this movement the head 30 is raised upwards with twice the speed of the tower 22 plus the pulleys 27 and 35.

When the tower reaches its upper end-of-travel position (configuration shown dashed in Figure 1) the piston 42 is retracted, to return the head 30 coaxial with the borehole. Then having connected the new drilling rod to those already mounted, the driving head 30 is operated to drill a new portion. At the same time the hydraulic piston 23 is made to retract, with consequent lowering of the tower 22 and head 30.

During this drilling operation the cable 28 is slack, whereas the secondary cable 34 is put under tension to drag the head 30 downwards by the effect of the descent of the pulley 35 with the tower 22.

When the head 30 and hence the tower 22 are in their lower end-of-travel position, the head is halted to enable a further rod to be connected and a further drilling cycle to be performed.

To extract the drilling rods from the borehole, the exact reverse of the cycle described for drilling is performed.

As can be seen, the two vertical portions of the cable 28 lie symmetrically about the vertical axis of the tower 22, with the result that the pull exerts no flexural stress on the tower.

With regard to the cable 34, as this mainly pulls it can induce a bending moment on the tower, but of negligible extent.

For equal overall size when in the transporting position, a drilling rig comprising a telescopic tower according to the invention enables rods to be used having a length greater than, if not double, the length of the rods usable by a traditional D machine with a fixed tower.

With reference to Figure 6, according to the present invention a drilling rod stowing and handling system, indicated overall by the reference

numeral 60, is combined with the drilling rig 110. This system is composed essentially of a plurality of tiltable containers of lattice type 61, a base 62 and a lifting jib crane 63.

In the embodiment shown in Figures 6-8 the base is of arched shape in plan view, however it can be of different configuration depending on working requirements.

The base 62, in the form of a rigid platform, is arranged in the immediate vicinity of the drilling rig close to the borehole and the service well.

Each container 61 has a rear or outer side 70, from which there extend three parallel branches 71 which define between them a pair of chambers or compartments 65 open in the direction of the drilling rig and able to receive two corresponding rows of drilling rods 50. As can be seen from Figure 8, in which the various containers are shown in their raised position, the foot 73 of each of them is hinged to the base 62 at the outer periphery thereof so that the containers can be arranged radially about the base 62 when in the lying position (Figure 6, position shown by dashed lines 61').

With reference to Figure 8, during assembly the containers 61 can be rapidly hinged to the base 62 by resting the feet 73 of each container on appropriate seats 78 and inserting a pin 79 through a hole 76 provided in the hinge seats 78, which are fixed in pairs along the outer periphery of the base.

The base 62 is suitably dimensioned so that when the containers 61 are in their erect position, an inner track 75 is left free for passage of the rods. In one end 75a of the track there is a circular hole 82 of slightly larger diameter than the rods 50.

The base 62 is arranged to the side of the drilling rig such that the hole 82 corresponds with the service well 151.

Again with reference to Figure 6, the jib crane 63 is mounted at the top of the drilling tower 122 and by means of a cable 80 supports a coupling device 81. This can be used both to carry the individual rods 50 from the containers 61 to the service well 151 and vice versa, and for hooking the top of the containers 61' when in their lying position and raising them into their erect position, or laying them on the ground on finishing boring.

The operation of the system according to the invention is as follows: the containers 61, complete with drilling rods 50, are firstly laid down on the ground with their feet 73 on the outer edge of the base. These are then connected to the base by inserting the pins 79 into the corresponding holes 76.

At this point the containers 61 can be raised into their working position either by the service crane 63, as shown in Figure 6, or by other site service cranes (not shown). When the containers are in their erect position their front feet 74 are locked to the base by quick locking means of known type and therefore not described or illustrated for simplicity. At this point the jib crane 63 is operated to move the coupling device 81 to one of the rods 50 contained in a container 61. The rod is coupled and extracted from the container.

Then, by rotating the crane about the drilling tower the rod 50 is dragged along the track 75 as far as its end 75a and is then let into the service well 151. From there the rod is taken by the driving head 130' of the drilling rig and moved into a position coaxial with the vertical line a through the centre of the borehole, where it is screwed to the already operating drill stem.

The reverse procedure is followed to extract the drill stem from the borehole. The rods are carried one by one into the service well and from there to the containers by the crane 63. As soon as the container is full of rods, it can be laid down horizontally and then loaded onto a transporting vehicle intended for another site.

The invention is not limited to the aforegoing description, which is to be considered purely as an illustration of the best method of implementing the equipment, and modifications in terms of the shape, dimensions and arrangement of the parts and of the constructional and operational details. For example the base can be straight instead of arched, with the containers being consequently of comb arrangement when laid on the ground. The invention includes all modifications which fall within its scope, as defined by the following claims.

Claims

1. A drilling machine of the type comprising a drilling tower (10) fixed in a reclinable manner on a transporting vehicle (11) and provided with motive power units (15) and a driving head (30) for driving the drill rods, characterised in that the drilling tower is of telescopic type slidable along a fixed guide structure or lattice (24) by the action of a hydraulic piston (23), the telescopic tower (22) being provided at its ends with a series of pulleys (27, 35) to allow the movement of flexible transmission means (28, 34) having one end connected to said driving head (30) and the other end connected to a point on the fixed structure (24), so as to form a closed ring about the the tower (22).

2. A machine as claimed in claim 1, characterised in that the driving head (30) is connected via an articulated quadrilateral linkage (40, 41, 42) to a rigid frame (31) slidable on the telescopic tower (22).

3. A machine as claimed in claim 2, characterised in that said articulated quadrilateral linkage comprises two rigid arms (40. 41) both hinged to said frame (31) and to said driving head (30), and a hydraulic piston (42) pivoted to one of said rigid arms (40, 41) and to the frame (31).

4. A machine as claimed in the preceding claims, characterised in that when the piston (42) is in its retracted state the driving head (30) is coaxial with the borehole, and when said piston (42) is in its expanded state the head (30) is in a position (30') displaced front the vertical axis of the borehole.

5. A machine as claimed in claim 1, characterised in that the tower (22) is provided upperly with pulleys (27) about which one of said flexible means (28) slides.

6. A machine as claimed in claim 1, characterised in that to the bottom of the tower (22) there is fixed at least one pulley (35) about which a second flexible means (34) slides.

7. A machine as claimed in claim 6, characterised in that said second flexible means (34) is connected to the lattice (24) via a tensioning device.

8. A machine as claimed in claims 1 to 6, characterised in that the vertical portions of each flexible means (28, 34) are arranged substantially symmetrical about the vertical axis of the tower (22).

9. A machine as claimed in claim 1, characterised by being provided with a rod stowing and handling system comprising:
   - a rigid base (62) provided with a plurality of hinging seats (78);
   - a plurality of rod containers (61), each provided at its foot (73) with corresponding means (73, 79) for its rapid hinging to the base (62);
   - means (63, 80, 81) for rotating the containers (61) in a vertical plane between a substantially vertical operating position and a lying-down position for their assembly and disassembly;
   - lifting means (63, 80, 81), mounted on the drilling rig (122), for withdrawing the rods (50) from the containers (61).

10. A system as claimed in claim 9, characterised in that said lifting and rotating means consist of a single jib crane (63) mounted on the drilling rig (122) and supporting by means of a cable (80) a coupling device (81) for the rods and the containers (61).

11. A system as claimed in claim 10, characterised in that the containers (61) consist of lattices with a comb-shaped cross-section defining compartments (65) open towards the drilling rig and arranged to receive corresponding rows of rods (50).

12. A system as claimed in claim 9, characterised in that said hinging seats (78) are fixed in pairs to at least one side of the base (62), the hinging means consisting of pins (79) to be inserted through holes (76) provided in the seats (78) in correspondence with one side of the base or foot (73) of the containers (61).

13. A system as claimed in claim 9, characterised in that the base (62) comprises, for passage of the rods (50), a track (75) provided on the opposite side to that on which the containers (61) are hinged.

14. A system as claimed in claims 9 and 13, characterised in that at one end of the track (75) there is provided in the base (62) a hole (82) for passage of the rods, the base being positioned in proximity to the drilling rig such that the hole (82) is coaxial with the vertical axis (b) through the service well (151).

15. A system as claimed in the preceding claims, characterised in that the base (62) has a plan shape in the form of an arch, the rod containers (61) being hinged onto its outer edge, and the rod passage track (75) being adjacent to its inner edge.

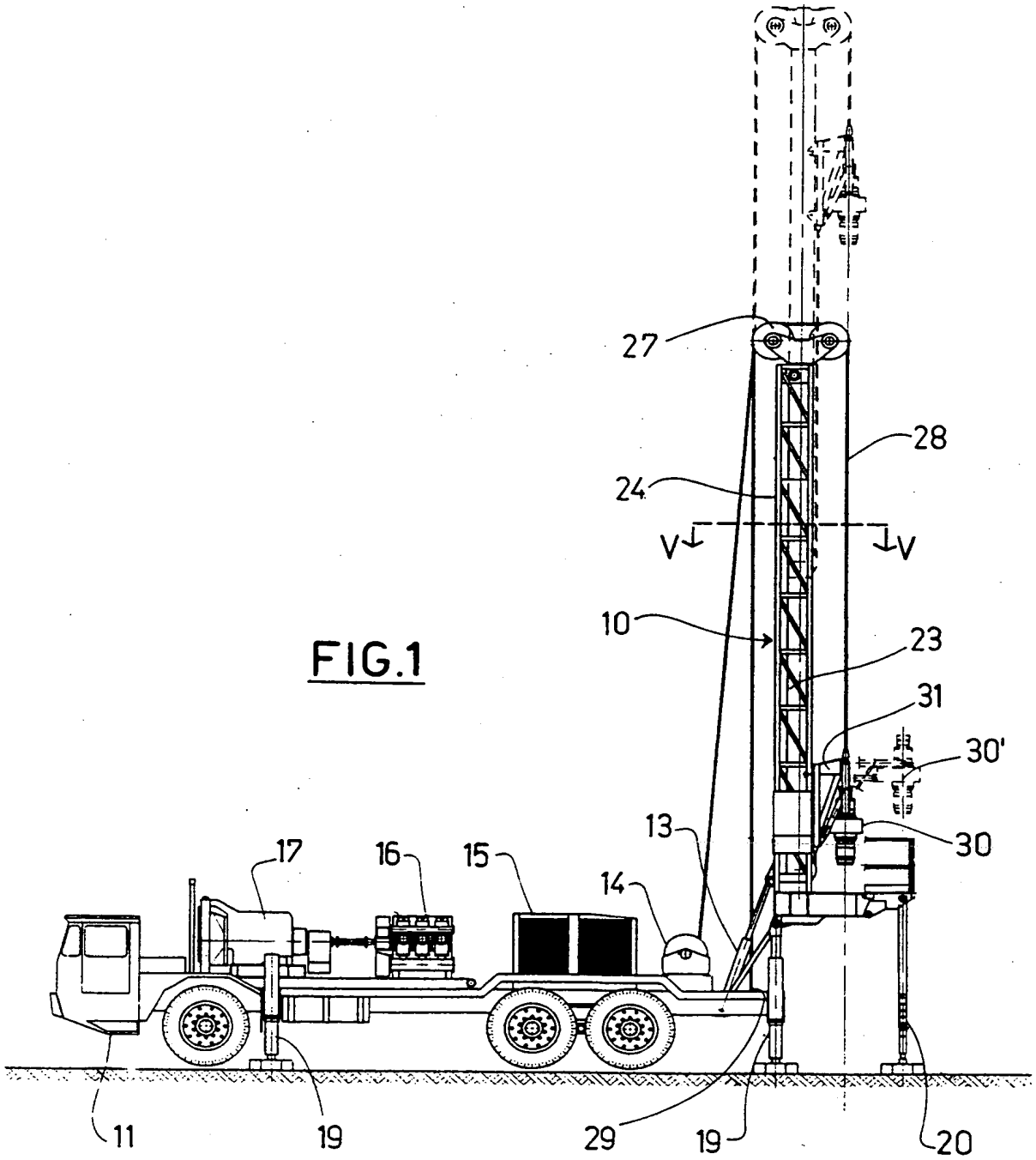

FIG.1

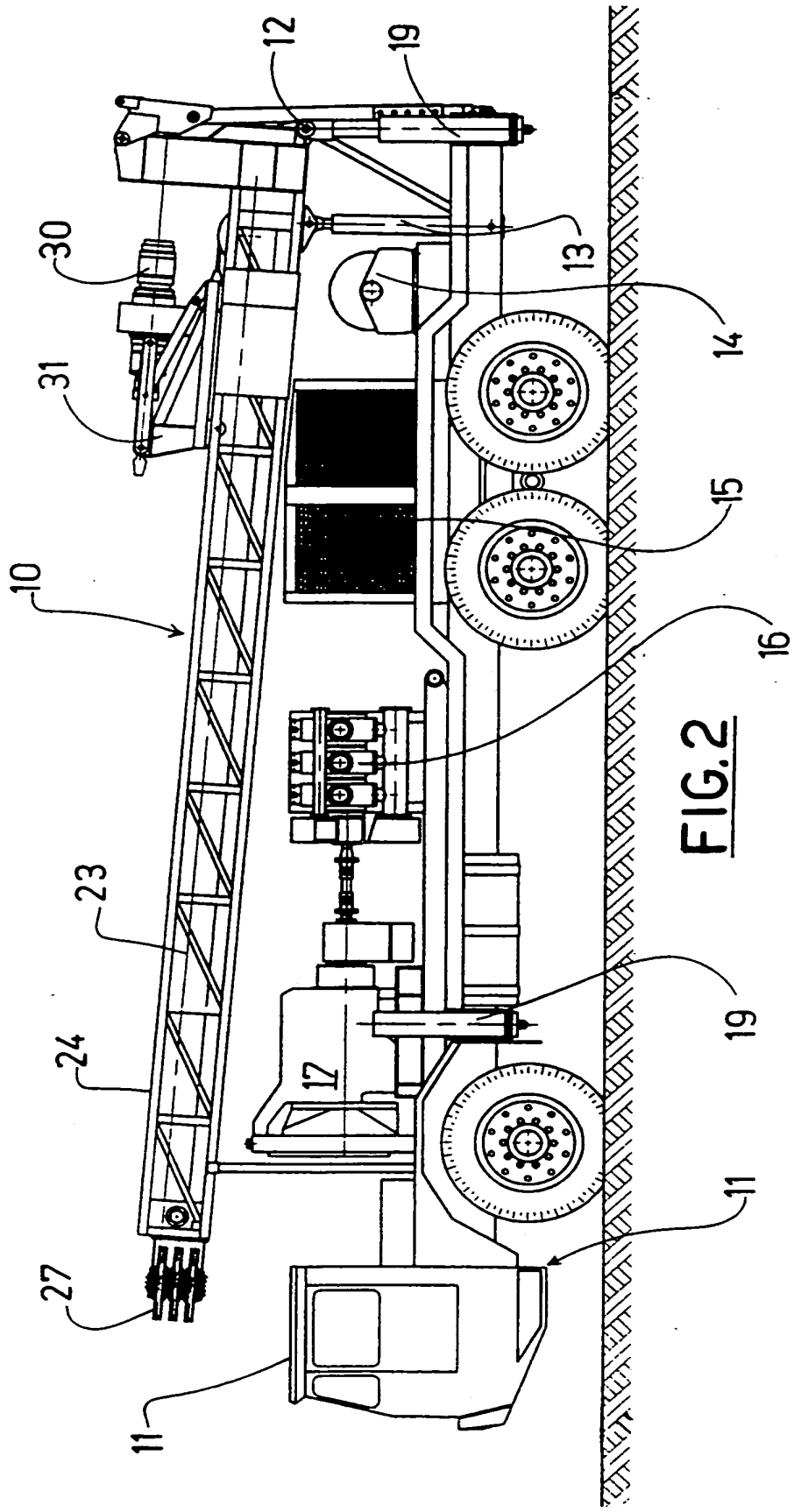

FIG.2

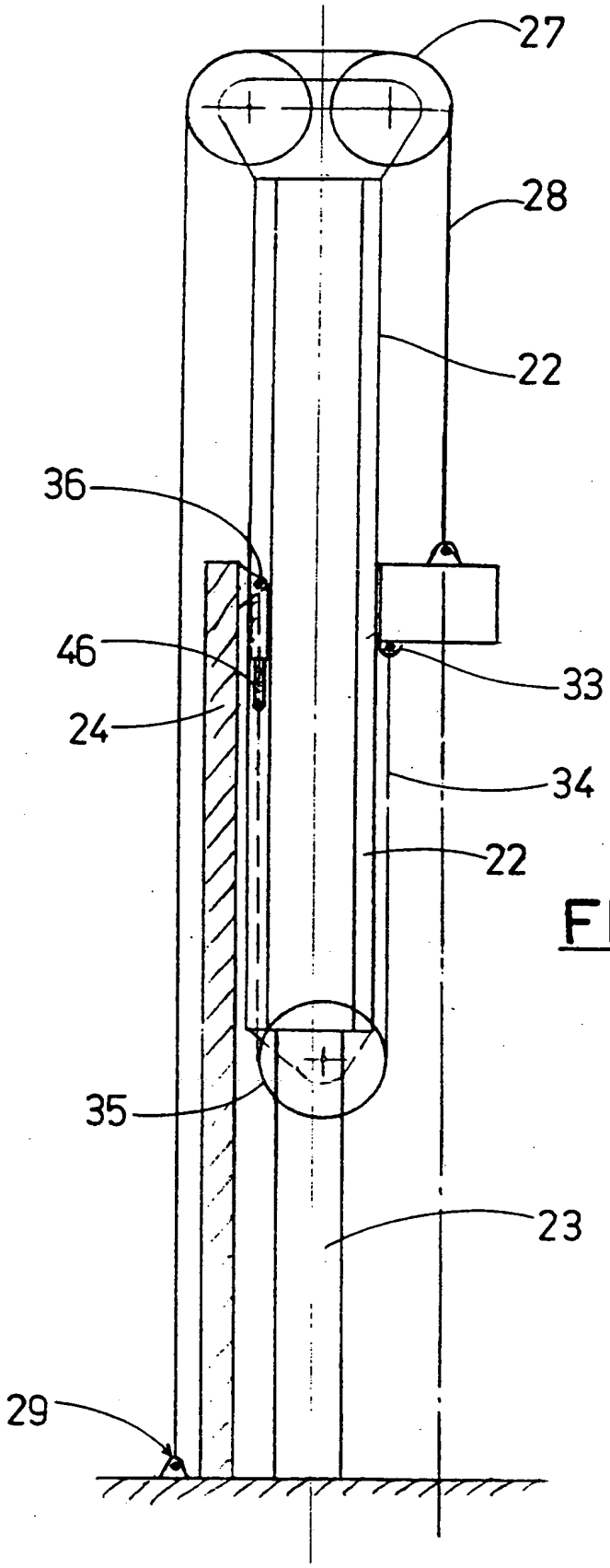

FIG.3

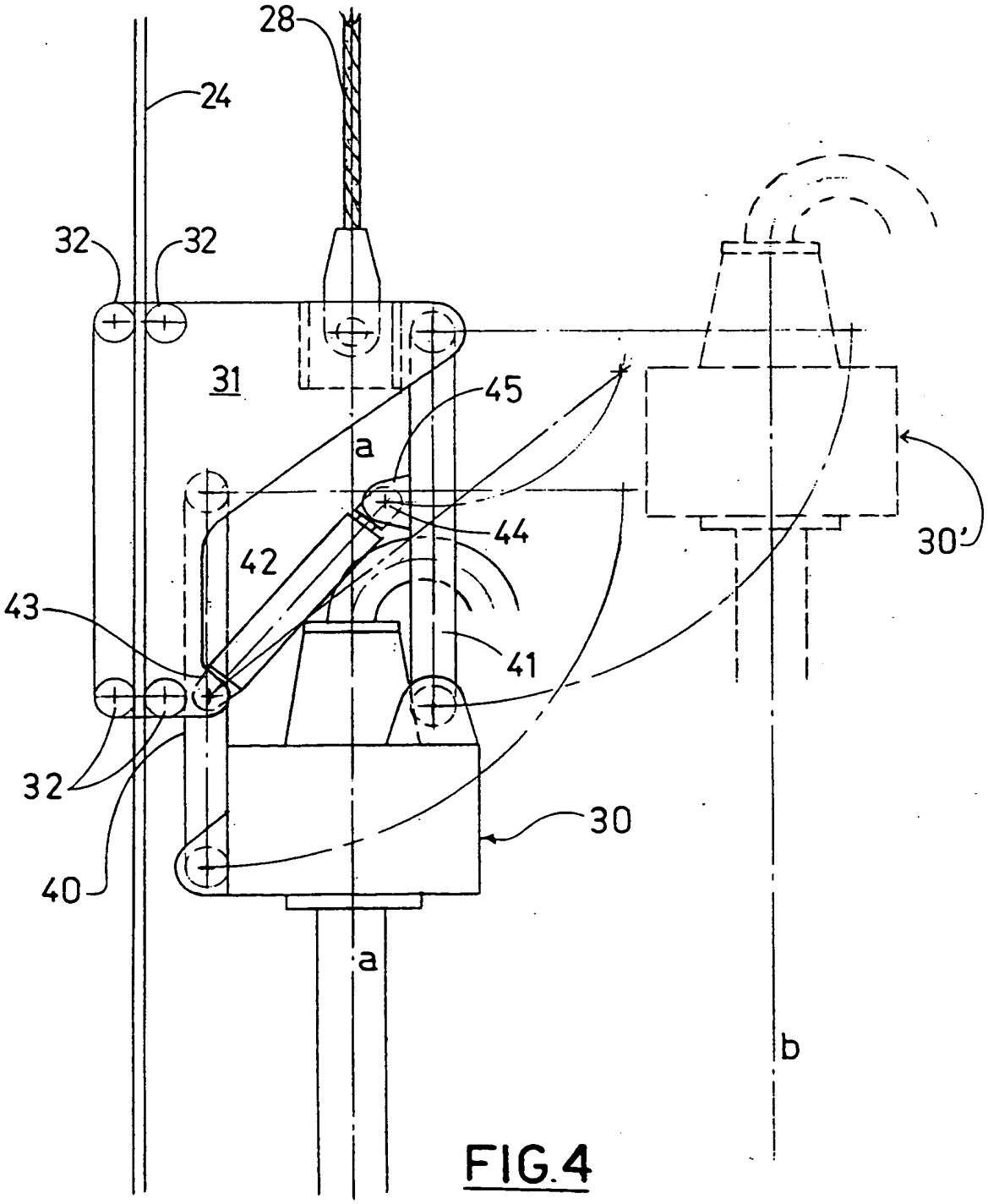

FIG.4

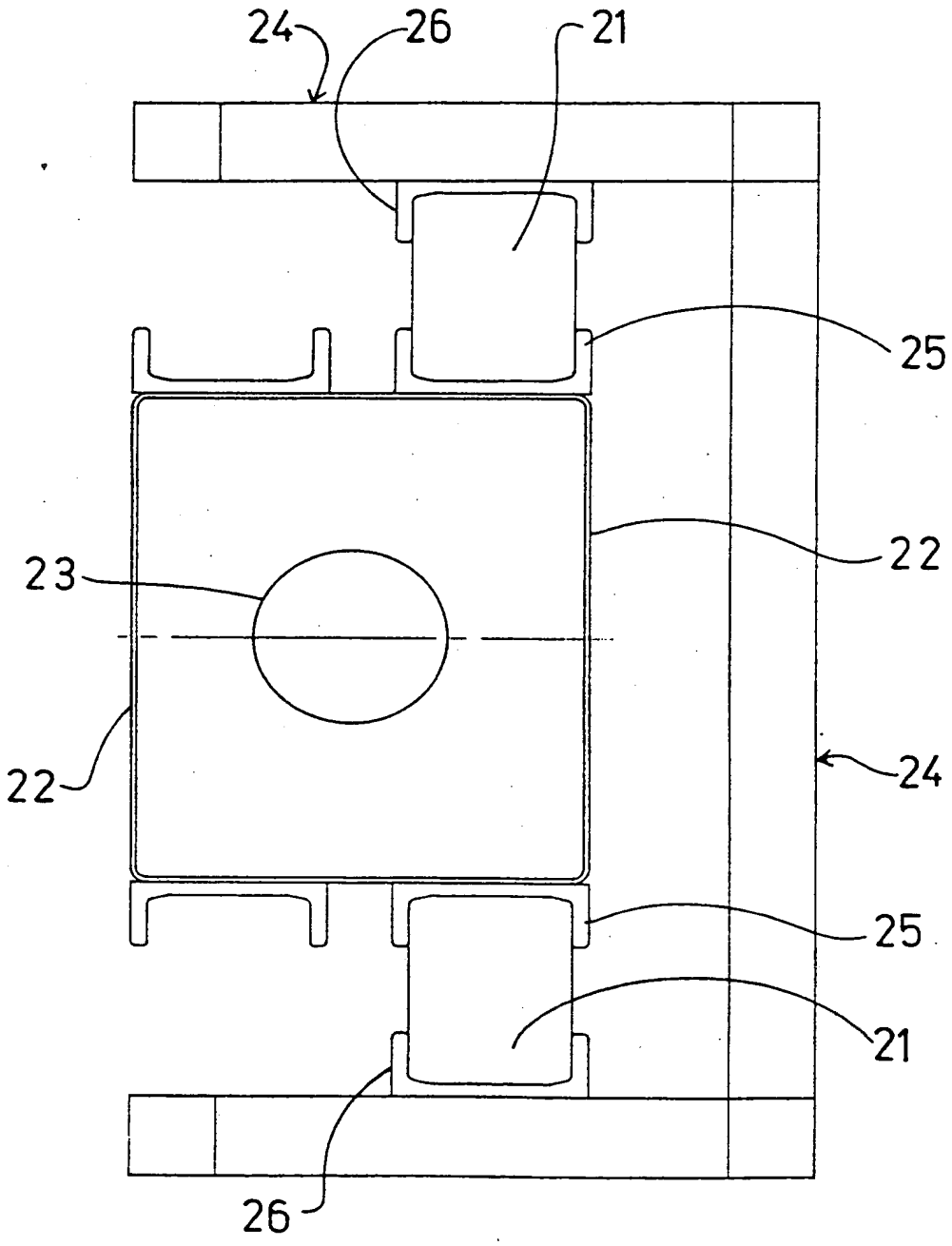

FIG.5

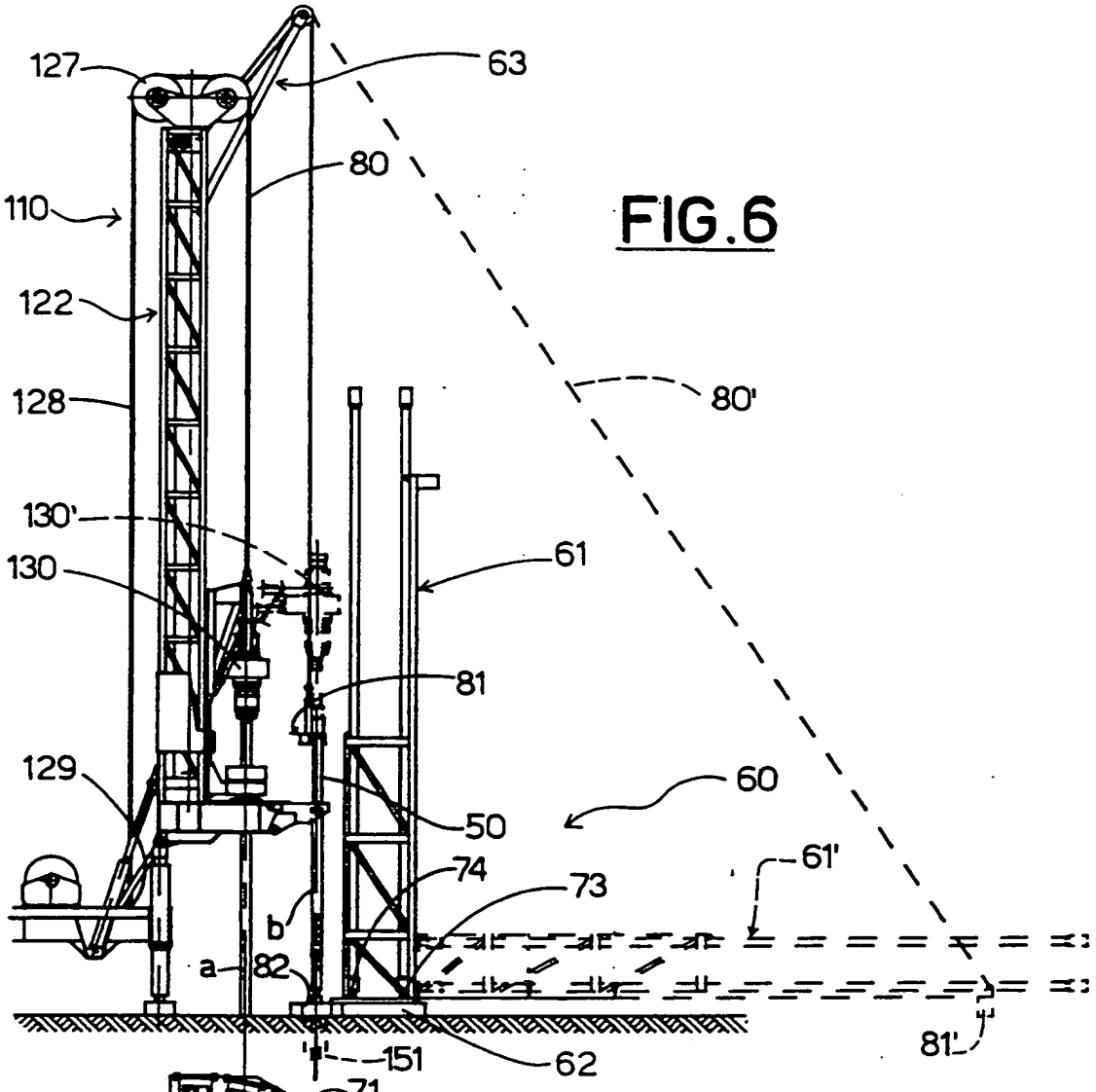

FIG.6

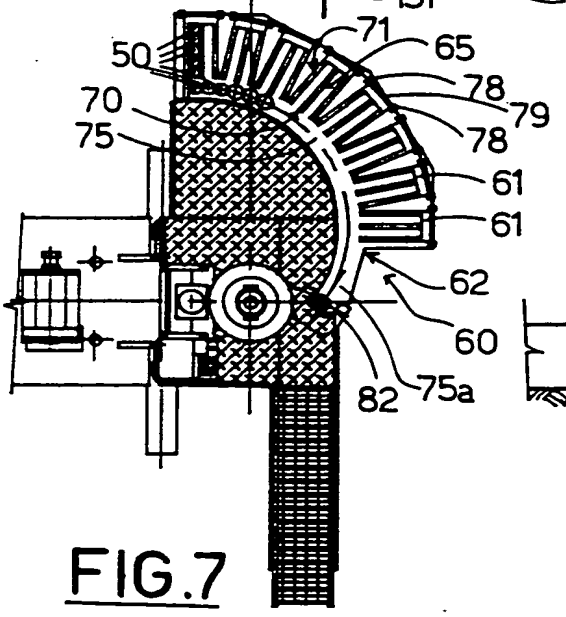

FIG.7

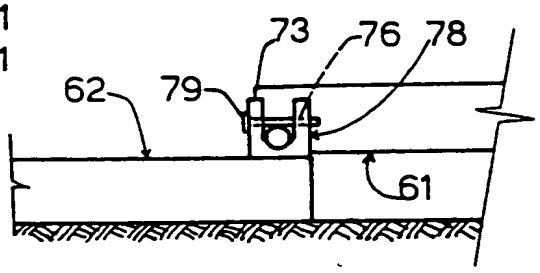

FIG.8

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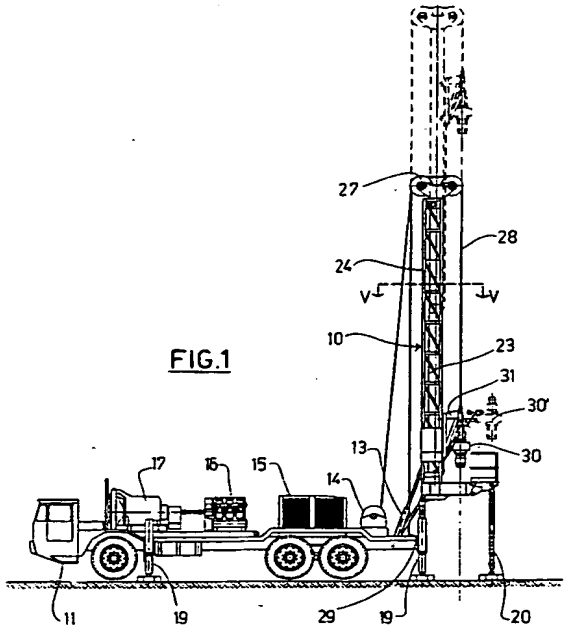

FIG.1

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 12 1752

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	US-A-4 020 909 (AIRAUDO) * column 4, line 21 - column 8, line 46; figures *	1,5,6,8 7	E21B15/00 E21B7/02 E21B19/14
Y A	US-A-4 434 860 (DEYO) * abstract; figures *	7 1	
A	CA-A-1 170 016 (CANADIAN DRILLING EQUIPMENT LTD.) * page 6, line 21 - page 7, line 22; figures *	1,5,6,8	
A	GB-A-2 079 817 (VARCO INTERNATIONAL INC.) * page 1, line 41 - line 87 * * page 3, line 60 - page 4, line 33; figures *	1-3	
A	US-A-4 036 508 (EDDY ET AL.) * abstract; figures *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	US-A-3 851 770 (JENKINS ET AL.) * column 2, line 3 - line 48; figures *	9,11,12	E21B
A	US-A-3 443 647 (JENKINS ET AL.) * abstract; figures *	9	
A	FR-A-2 092 611 (SOC. NAT. D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION) * page 1, line 22 - line 37; figures *	9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01 JULY 1993	LINGUA D.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)

European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid.

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

see sheet -B-

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid.

namely claims:

☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims:

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 2-8 : Transportable telescopic drilling machine with a drilling unit movable transversely of the axis of the well to a laterally offset position.

2. Claims 9-15 : Rod stowing and handling system for a drilling machine.

MOTIVATION

A drilling machine according to claim 1 is known from US 4 020 909.

Therefore claims depending on claim 1 can be grouped into 2 subjects (as expressed above), having in common only the known features present in claim 1 (non unity "a posteriori").

The search has been carried out for claim 1 and the first invention (claims 2-8) mentioned in the claims.